

Small, Portable Altimeter Operates from a Single Cell

by Todd Owen

Some sports enthusiasts want to know altitude changes from an initial elevation. A small, lightweight, portable altimeter is easy to design using modern micromachined pressure transducers. Inverting barometric pressure and compensating for nonlinearities in air-pressure changes with respect to altitude produces a reasonably accurate altimeter.


Figure 1 shows a small, handheld altimeter based on a micromachined pressure transducer. The circuit takes advantage of the inverse relationship between air pressure and altitude. The aim of this circuit is to be small, lightweight, and portable. Accuracy is not paramount; errors as high as 3%, such as a 300ft error at 10,000ft altitude, are acceptable. The speed of the circuit is also not critical: Extreme changes in altitude in milliseconds may prove fatal to whoever is attempting to read the output.

The heart of the altimeter is an NPC-1220-015-A-3L pressure transducer. This 5k bridge provides 0mV to 50mV of output voltage for a 0psi to 15psi pressure range. To power the transducer and signal-conditioning circuitry, LT1307 (IC1), generates 5V from a single AA battery, and a charge pump generates a -5V supply. The pressure transducer is driven by IC3B (LT1490), which uses a reference voltage and a setting resistor on the transducer to generate appropriate drive current.

The output of the transducer drives an LT1167 instrumentation amplifier (IC2) which provides an initial gain of 21. A nonlinear gain stage, composed of IC3A and associated components, then inverts the output of the instrumentation to provide a voltage that is inversely proportional to air pressure. D4 and R1 introduce the nonlinear gain, and the final output is directly proportional to altitude.

R2 performs gain calibration in the signal-conditioning circuitry. This potentiometer calibrates out any normal variations in part tolerances and sets the altimeter for a 100mV change in output for every 1000ft of altitude. The circuit has some initial offset, as well as an offset that is determined by barometric pressure variations. You can use R3 to R5 to null this offset, giving a 0V to 1V output for 0ft to 10,000ft of altitude.

Altimeter testing was performed using a DeHavilland DHC-6 Twin Otter for an ascent to 13,000ft, followed by

free descent—limited by the engineer's parasitic drag—to 3000ft. Subsequent deployment of an aerodynamic decelerator (Precision Aerodynamics Icarus Omega 190) prevented engineer injury or circuit damage. Aircraft rental for testing is available at many local airports. Extensive instruction in free descent and the use of aerodynamic decelerators are highly recommended before undertaking testing of this nature. Contact USPA at (703) 836-3495 for further information. 

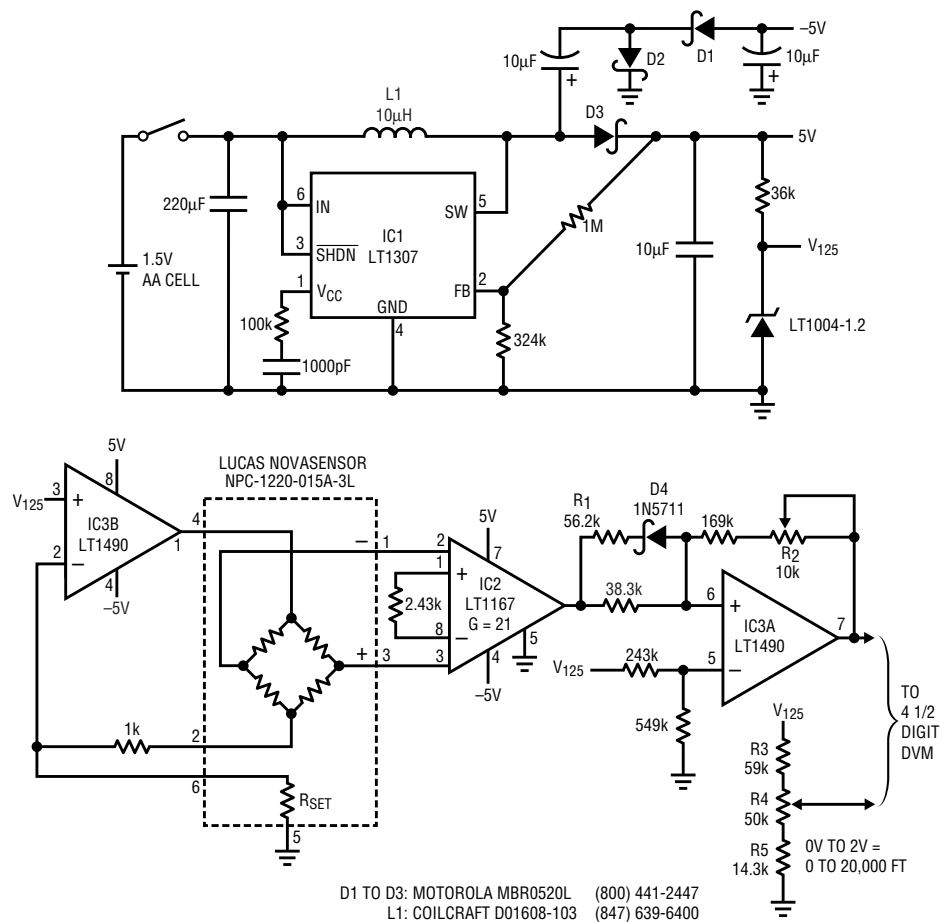


Figure 1. To produce a reasonably accurate altimeter, conditioning circuitry inverts the barometric pressure of a micromachined pressure transducer and compensates for nonlinearities in air-pressure changes with respect to altitude.